

# **RENAUD BROS., INC.**

283 Fort Bridgeman Road #2, Vernon, VT 05354

phone (802) 257-7383

fax (802) 257-7308

## **Townshend STP SCTT (1) Item 900.645 – SP Rehabilitating Covered Bridge Superstructure**

### **Re-cambering**

The bridge will be cambered evenly through the bridge. At each shoring needle beam the bridge will be lifted. When the bridge is at a consistent starting elevation the cambering jacking will commence. Twenty ton bottle jacks and wood blocking will be utilized to manipulate the truss to the final camber. The bridge will be raised 1" between nodes 5 and 38. Then starting at node 10 we would raise it another inch to node 33. Then another inch between 15 and 28, and the final inch between nodes 20 and 23. The cambering process may take several days as the wood flexes into position. During this process we need to watch for lifting at other points other than what's intended. If the structure is lifting without cambering, bolts will need to be removed so the chords can slide and flex. In particular the supplemental bottom chords will most likely need to be removed as we will be fighting the through bolts and shear blocks to get the final camber. In any locations where lattice needs to be replaced the chord needs to be removed just to get at the trunnels.

Calculations are included for the loads induced on the shoring to install the camber. A sketch showing how the lateral bracing will be done with blocking and heavy duty ratchet straps is attached.

### **Piece Re-Placement**

The Roof will be disassembled in sections of 50 feet or less. The bottom chords will be replaced followed by the lattice work followed by the top chords. We will work both sides in 50 foot sections or less putting the structure back together complete as we go along.

Once the bridge is rebuilt, it will be set back down on the abutments and covered for the coatings application. At this time the abutment and pier work will be done. Once the bridge is coated and set back on the piers and abutments the temporary cover and shoring removal will commence.



## MEMO

DATE: December 11, 2015

TO: Renaud Brother Construction

FROM: Ronald K. Bell, PE  
Bell Engineering

SUBJECT: Jacking Loads

One way to not overstress the trusses during jacking would be to limit the + camber in the W12x40 needle beams to 1/4". The unfactored load to induce a 1/4" camber is 23.123 kips on each side. I added 2.5 kips to the dead load of the truss to account for a force to overcome the inertia of the truss. Beyond a 1/4" camber you begin to exceed the allowable deflection of the beam. The camber can be checked by placing a straight edge under the needle beams between the longitudinal beams. Jacking should stop when the 1/4" camber occurs or you have lifted the truss approx. 1" at the needle beam. Proceed to the next jacking point when either condition occurs.

Thank you

Ron



## Steel Beam

File = C:\Users\Ron\DOCUME~1\ENERCA~1\TOWNSE~1\EC6  
ENERCALC, INC. 1983-2013, Build:6.13.8.31, Ver:6.13.12.31

Lic. #: KW-06009396

Licensee : Bell Engineering

Description : **W12x40 CROSS BEAM ALLOWABLE DEFLECTIONS**

### CODE REFERENCES

Calculations per AISC 360-05, IBC 2006, CBC 2007, ASCE 7-05

Load Combination Set : ASCE 7-05

### Material Properties

Analysis Method : **Load Resistance Factor Design**

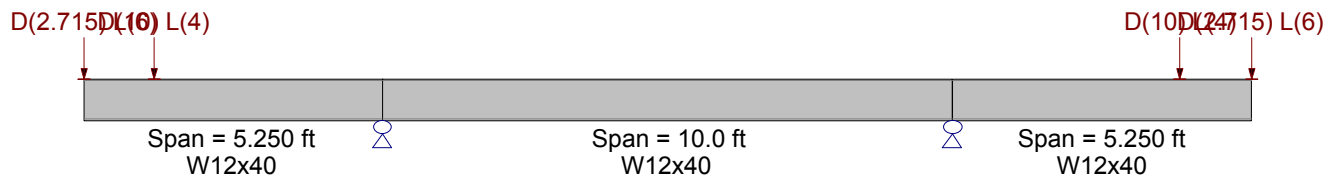
Beam Bracing : **Completely Unbraced**

Bending Axis : **Major Axis Bending**

Load Combination **ASCE 7-05**

Fy : Steel Yield : **50.0** ksi

E: Modulus : **29,000.0** ksi



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Load(s) for Span Number 1

Point Load : D = 2.715, L = 6.0 k @ 0.0 ft

Point Load : D = 10.0, L = 4.0 k @ 1.250 ft

Load(s) for Span Number 3

Point Load : D = 10.0, L = 4.0 k @ 4.0 ft

Point Load : D = 2.715, L = 6.0 k @ 5.250 ft

### DESIGN SUMMARY

**Design OK**

Maximum Bending Stress Ratio = **0.719** : 1  
Section used for this span **W12x40**  
Mu : Applied **141.763** k-ft  
Mn \* Phi : Allowable **197.045** k-ft  
Load Combination **+1.20D+1.60L+0.50S+1.60H**  
Location of maximum on span **10.000** ft  
Span # where maximum occurs **Span # 2**

Maximum Shear Stress Ratio = **0.299** : 1  
Section used for this span **W12x40**  
Vu : Applied **31.509** k  
Vn \* Phi : Allowable **105.315** k  
Load Combination **+1.20D+1.60L+0.50S+1.60H**  
Location of maximum on span **10.000** ft  
Span # where maximum occurs **Span # 2**

#### Maximum Deflection

Max Downward L+Lr+S Deflection **0.323** in Ratio = **389**  
Max Upward L+Lr+S Deflection **-0.118** in Ratio = **1,015**  
Max Downward Total Deflection **0.688** in Ratio = **183**  
Max Upward Total Deflection **-0.253** in Ratio = **473**

### Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.6885	0.000		0.0000	5.063
	2	0.0000	0.000	D+L	-0.2535	5.063
D+L	3	0.6855	5.250		0.0000	5.063

### Vertical Reactions - Unfactored

Support notation : Far left is #1

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		23.123	23.123	
D Only		13.123	13.123	
L Only		10.000	10.000	
D+L		23.123	23.123	



## Steel Beam

File = C:\Users\Ron\DOCUME~1\ENERCA~1\TOWNSE~1\EC6  
ENERCALC, INC. 1983-2013, Build:6.13.8.31, Ver:6.13.12.31

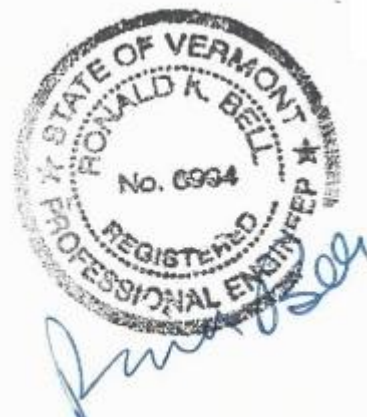
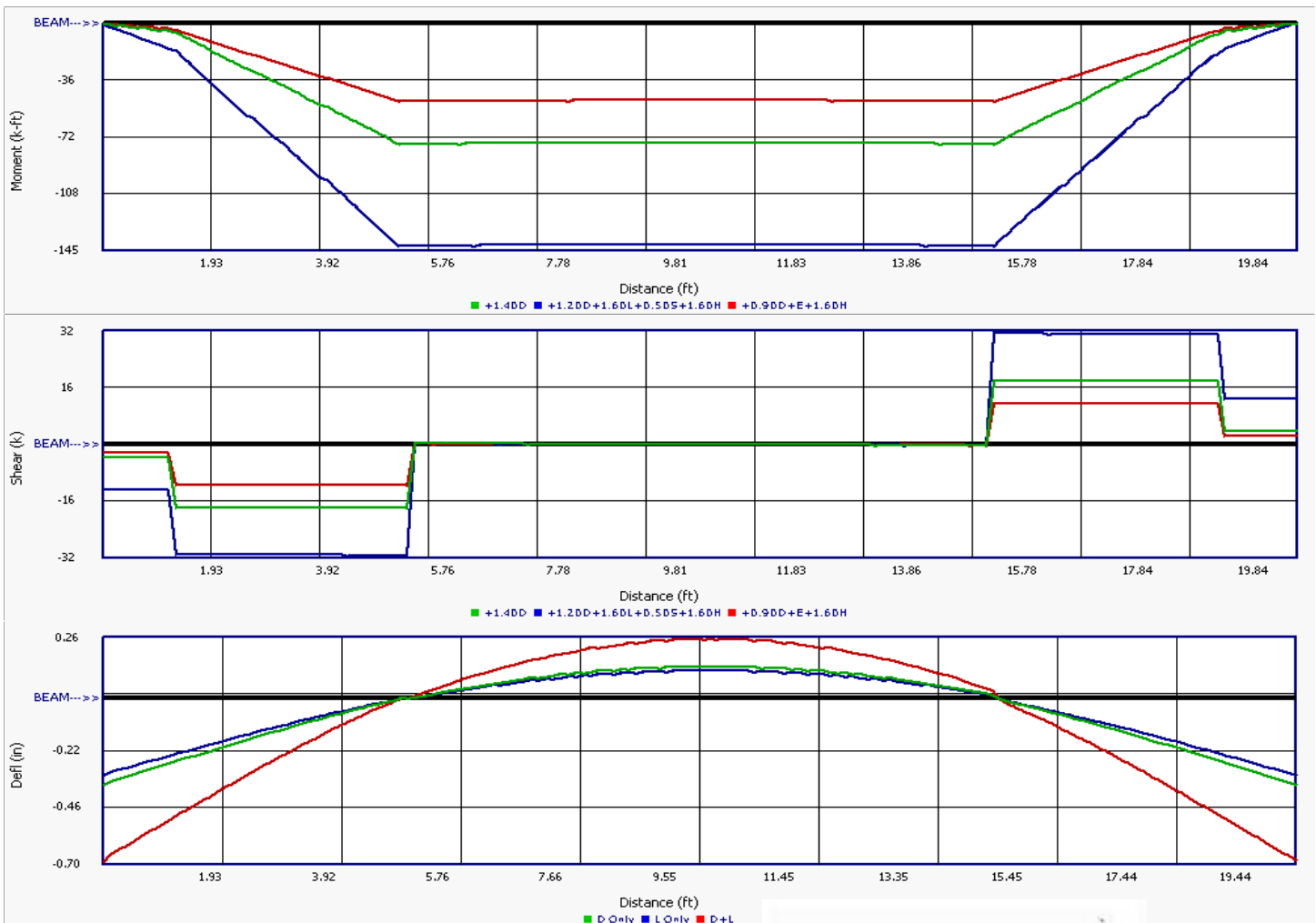
Lic. #: KW-06009396

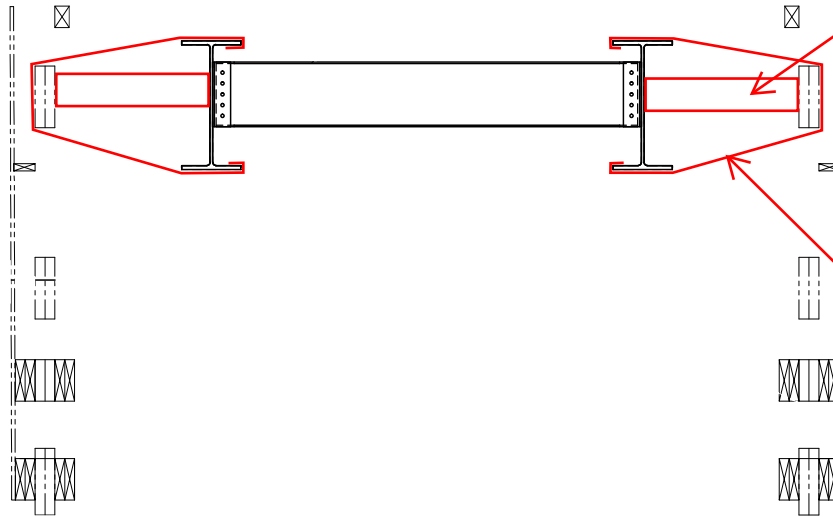
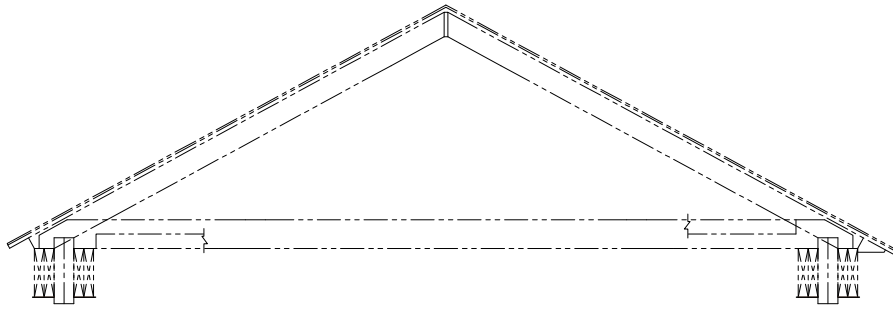
Licensee: Bell Engineering

Description: W12x40 CROSS BEAM ALLOWABLE DEFLECTIONS

### Steel Section Properties : W12x40

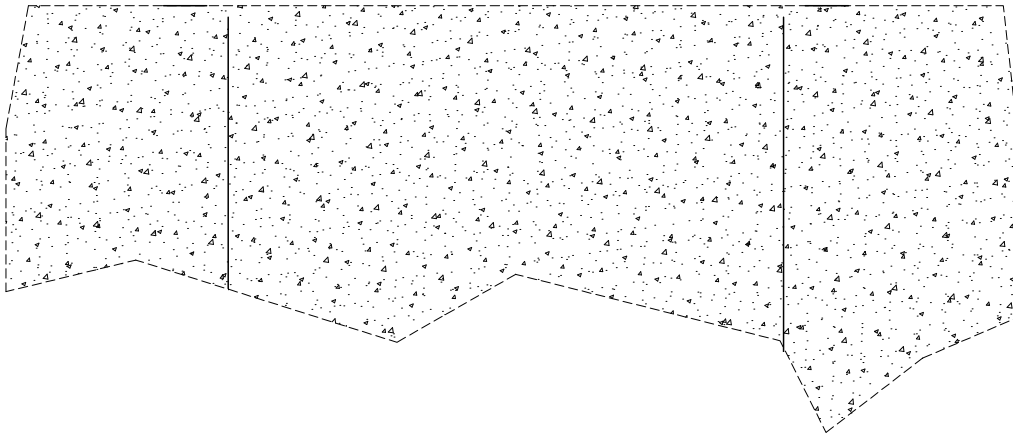
Depth	=	11.900 in	I <sub>xx</sub>	=	307.00 in <sup>4</sup>	J	=	0.906 in <sup>4</sup>
Web Thick	=	0.295 in	S <sub>xx</sub>	=	51.50 in <sup>3</sup>	C <sub>w</sub>	=	1,440.00 in <sup>6</sup>
Flange Width	=	8.010 in	R <sub>xx</sub>	=	5.130 in			
Flange Thick	=	0.515 in	Z <sub>x</sub>	=	57.000 in <sup>3</sup>			
Area	=	11.700 in <sup>2</sup>	I <sub>yy</sub>	=	44.100 in <sup>4</sup>	W <sub>no</sub>	=	22.800 in <sup>2</sup>
Weight	=	39.827 plf	S <sub>yy</sub>	=	11.000 in <sup>3</sup>	Sw	=	23.500 in <sup>4</sup>
Kdesign	=	1.020 in	R <sub>yy</sub>	=	1.940 in	Q <sub>f</sub>	=	11.300 in <sup>3</sup>
K1	=	0.875 in	Z <sub>y</sub>	=	16.800 in <sup>3</sup>	Q <sub>w</sub>	=	27.800 in <sup>3</sup>
r <sub>ts</sub>	=	2.210 in	r <sub>T</sub>	=	2.140 in			
Y <sub>cg</sub>	=	5.950 in						





WOOD BLOCK CUT  
TO FIT WITH  
LATTICE PLUMB

HEAVY DUTY  
TRUCKING STRAP  
RATED FOR 3300 LBS  
MINIMUM



SHEET NAME:  
**LATERAL BRACING CONTROL**

REV. NO.	DATE:	<div><div><div>B.</div><div>R</div><div>I.</div></div><div>RENAUD BROS. INC.</div><div>STEEL SALES &amp; FABRICATION</div><div>VERNON VT. USA</div><div>283 FT. BRIDGMAN RD. VERNON VT., 05354</div><div>PH. (802) 257-7383 FAX. (802) 257-7308</div></div>	PROJECT NAME:			SHEET NO.
			TOWNSHEND			
			PROJECT NO:			
			STP SCTT(1)			SK-1
			DRAWN BY:	CHK'D BY:	DATE:	
		CE	M.R.	12/11/2015		